EGG-NEGLECT IN THE WILSON'S STORM PETREL

Jaime E. Pefaur

The purpose of this study was to determine the frequency and duration of egg-neglect periods and their influence on nest temperatures in Wilson's Storm Petrel (*Oceanites oceanicus*). The study was done on Robert Island, South Shetland, Antarctica. The island, largely ice-covered, has been described by Schlatter et al. (1968) and by Pefaur and Murua (1972). The so-called Robert Island peninsula is a narrow western extension about 2 km in length and 200 to 500 meters in width. Physiographically, the peninsula is a plateau averaging about 30 to 40 meters above sea level, but with some elevations up to 80 meters; a narrow beach surrounds the plateau. Mean summer temperature is between 0° and 2.5°C, and the peninsula becomes ice-free.

Nesting species of birds there include *Macronectes giganteus*, *Daption capensis*, *Catharacta skua*, *Larus dominicanus*, *Sterna vittata*, as well as *Oceanites oceanicus*. *Pygoscelis antarctica*, *P. papua*, *P. adeliae*, *Phalacrocorax atriceps*, and *Chionis alba* have been recorded as non-breeding visitors (Pefaur and Murua, 1972). The storm petrel population was estimated in 1969 as between 1,000 and 2,000 individuals (Pefaur and Murua, 1972), dispersed in 13 nesting colonies on the peninsula. Nests were placed 20 to 50 cm deep inside rock crevices and were cup-shaped, made of mosses and lichens, with an average diameter of 6 cm and depth of 1 cm.

On the Argentine Islands, Graham Land, Roberts (1940) recorded temperatures of burrows occupied by incubating *O. oceanicus* and found that temperature remained above that of the ambient air. The burrows there were covered with a rich layer of mosses and lichens, in marked contrast to the more usual situation as found on Robert Island, where the nests were placed in naked rock crevices. Nest temperature thus dropped drastically as soon as the incubating bird left in the latter locality.

METHODS

Selection of study nests was very difficult for they were dispersed in a large area and well hidden. Furthermore, the nests had to be relatively close to our temporary headquarters in order that they could be checked every six hours, in all weather. The three nests selected were on a north-facing slope, in burrows which were not so deep as to hide them. From 15 January to 22 February 1969, nests were checked at 6:00, 12:00, 18:00, and 24:00 hours every day. A #408 probe was initially placed under the egg in the adults' absence, and connected by 50 meters of lead to a fixed thermistor (Yellow Springs Instrument Company, Dayton, Ohio). Ambient air temperature was recorded at the thermistor, using a #405 probe. Nesting behavior of the petrels was not altered by this

TABLE 1

DURATION OF BROODING AND EGG-NEGLECT PERIODS IN *OCEANITES OCEANICUS* ON ROBERT ISLAND, SOUTH SHETLAND ISLANDS, ANTARCTICA*

Unsuccessful (Nest 1) Period (in hours) of		Successful Nests (Nest 2) Period (in hours) of		(Nest 3) Period (in hours) of	
Brooding	Neglect	Brooding	Neglect	Brooding	Neglect
12	84	36	30	60	6
36	48	36	6	72	48
60	36	54	18	66	42
90	6	6	12	18	18
48	18	54	42	18	hatched
12	12	198	18	———	———
42	30	12	36	$\bar{x}$ 48.8	28.5
42	12	78	18		
24	18	120	hatched		
6	deserted	———	———		
———	———	$\bar{x}$ 66.0	22.5		
$\bar{x}$ 37.2	29.3				

* All observations begun January 16.

procedure. Dates on which incubation was initiated were, unfortunately, unknown in all cases; however, in all three nests incubation was well underway.

RESULTS

Periodic egg-neglect during incubation was known to occur in *O. oceanicus* in Graham Land (Roberts, 1940), and it occurred in the three nests studied by me (Table 1). Nest 1 had nine periods of egg-neglect (before the nest was abandoned), averaging 10.1 hours/day. Nest 2 had eight egg-neglect periods, averaging 5.4 hours/day, and nest 3, at a more advanced stage, had only four egg-neglect periods, averaging 7.6 hours/day. The longest periods of neglect were 84 hours for nest 1, 42 hours for nest 2, and 48 hours for nest 3.

Every time a bird left the nest and was not replaced immediately by its mate, the nest temperature quickly dropped to ambient air temperature (Fig. 1). Every major trough in the nest temperature curve represented an absence of a brooding bird. On the other hand, each time the nest temperature exceeded 10°C corresponded with a sitting bird. No definite patterns of egg-neglect could be seen in the data. Periods of neglect followed as soon as 6 hours after the previous period of neglect and as long as 198 hours after such a period.

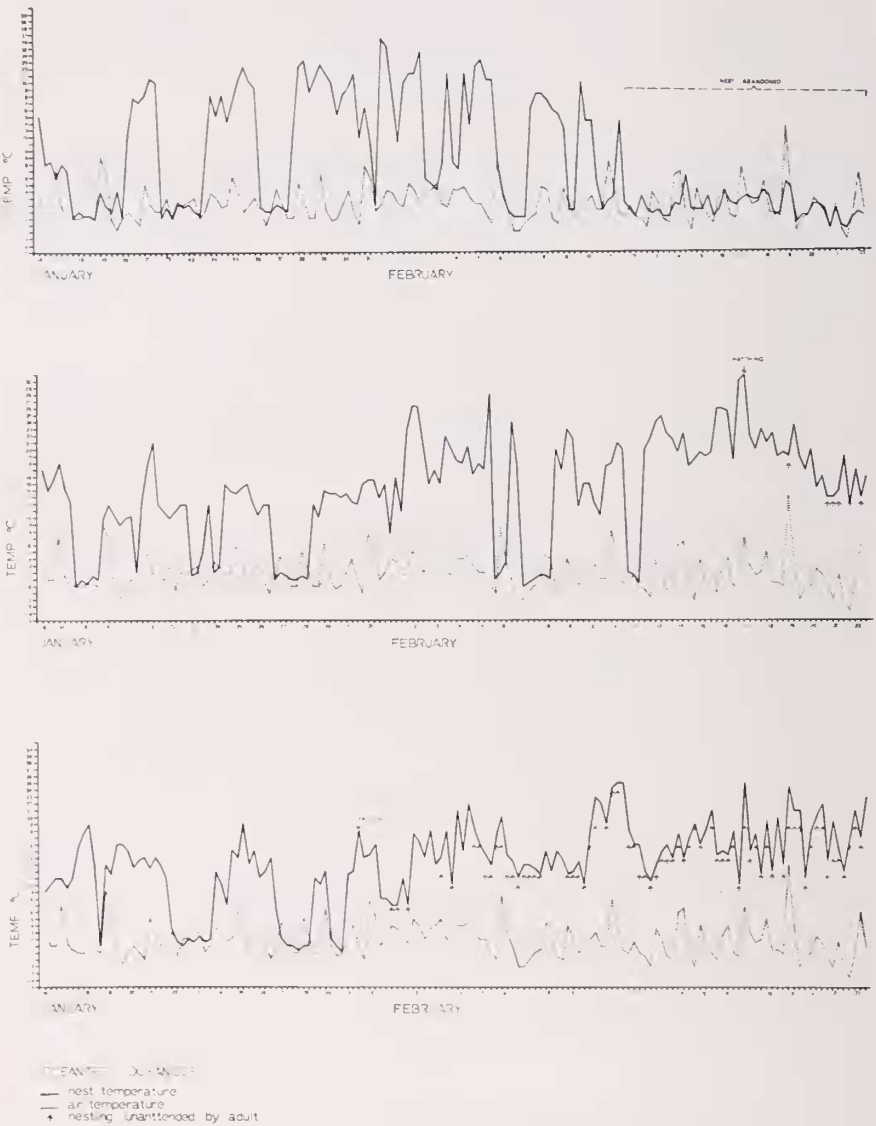

FIG. 1. Nest temperatures in three nests of *Oceanites oceanicus* on Robert Island, South Shetland, Antarctica. Nest 1 (upper graph) was abandoned, but nests 2 and 3 (middle and bottom graphs, respectively) successfully hatched chicks.

The temperatures recorded by the thermistor probe are actually somewhat lower than the incubation temperature of the embryo. Westerskov (1956) found in *Phasianus* that the temperature on the upper surface of incubated eggs was about two to ten degrees higher than the lower surface. Drent (1967) recorded nest bottom temperatures of 27°–35°C, but internal egg temperature was constant at 39°C. In *Puffinus* and *Diomedea* internal egg temperatures are about 36°C (Howell and Bartholomew, 1961a, b). Although not reflecting actual incubation temperatures, there is no reason to suppose that the thermistor values for nest temperature do not also indicate that the eggs were affected.

Following hatching, a parent brooded the nestling for the first 48 hours in nest 2, and for 36 hours in nest 3. Subsequently, the chick was left alone an increased number of times (Fig. 1). Body temperature of the newly hatched chick is low, Roberts (1940) having recorded it as 25° and 27°C in unattended chicks during their first day of life. Later a body temperature is attained which fluctuates about 37°C; body temperature in petrels is fully discussed by Warham (1971).

DISCUSSION AND CONCLUSIONS

Temporary suspension of incubation and concomitant periods of egg-neglect have been recorded for many Procellariiformes. The species listed in Table 2 are known to hatch successfully subsequent to chilling periods. Many more species (i.e. *Daption capensis*, *Pagodroma nivea*, *Pterodroma phaeopygia*, *Puffinus lherminieri*, *Halobaena caerulea*, *Calonectris diomedea*, and *Oceanodroma leucorhoa*; from several sources) are known to have periods of egg-neglect, but there is no information on subsequent successful hatching. In the incubation periods of some circumpolar species, where the temperature sometimes reaches freezing, the egg can be chilled for up to two days and still hatch afterwards, as the present study affirms.

It is possible that egg-neglect may have evolved as opportunistic behavior on the part of Procellariiformes that modifies the length of the incubation period, with the result that the chick leaves the nest when food is most abundant (Prévost and Bourlière, 1955). Maher (1962) found that timing of fledging in Snow Petrels (*Pagodroma nivea*) was an adaptation permitting "the recently fledged juveniles to encounter a maximum food supply in their early period of independence," and suggested that several breeding features of Procellariiforms are correlated with a mid-April peak in the standing crop of Antarctic zooplankton.

It is still necessary to establish when the first egg-neglect period occurs in the *O. oceanicus*: the present data were recorded only in the last two-thirds of the incubation period, which extends from November to March on Robert

TABLE 2

EGG-NEGLECT PERIODS IN PROCELLARIIFORMES AT NESTS IN WHICH SUCCESSFUL HATCHING OCCURRED

Species	Egg-neglect Period (days)	Source
Diomedea immutabilis, Laysan Albatross	4 to 5	Hadden, 1941
Diomedea upomophora, Royal Albatross	2	Richdale, 1952
Pterodroma macroptera, Great-winged Petrel	1	Warham, 1956
Pachyptila turtur, Narrow-billed Prion	1	Richdale, 1965a
Pachyptila desolata, Dove Prion	1 to 2	Tickell, 1962
Procellaria puffinus, Manx Shearwater	1 to 7*	Matthews, 1954
Puffinus griseus, Sooty Shearwater	4**	Richdale, 1963
Pelagodroma marina, White-faced Storm Petrel	1 to 4	Richdale, 1965b
Oceanites oceanicus, Wilson's Storm Petrel	1 to 2	Roberts, 1940
Hydrobates pelagicus, Storm Petrel	1 to 5	Lockley, 1932 Davis, 1957
Fregatta tropica, Black-bellied Storm Petrel	1	Beck and Brown, 1971

* "Clearly the seven days survived by an egg in the burrow is not the limit of the resistance to chilling, because others remained viable for up to 13 days in the laboratory" (Matthews, 1954).
** Thought to be due to the investigator disturbance (Richdale, 1963).

Island. It is possible that in the first third of the period the embryos have different resistance to chilling. However, in the Manx Shearwater (*Puffinus puffinus*), the stage of development at which chilling occurs seems unimportant (Matthews, 1954).

SUMMARY

Frequency and duration of egg-neglect periods in *Oceanites oceanicus* were studied on Robert Island, South Shetland, Antarctica. Of three nests observed, two successfully hatched young, even though they experienced four and eight periods of egg-neglect before hatching, averaging 7.6 and 5.4 hours/day, respectively. Longest periods of egg-neglect were 42 and 48 hours. Body temperature of newly hatched chicks was 25°–27°C. Prolonged egg-neglect may be common in Procellariiformes, and may modify the length of the incubation period so that the chick fledges when food is most abundant at sea.

RESUMÉN

Este estudio se llevó a cabo en la Isla Robert, Shetland del Sur, Antártica, durante la XXIII Comisión Antártica Chilena. El objetivo principal fue para establecer la frecuencia de los abandonos del nido durante la incubación de *Oceanites oceanicus* y ver cuales eran sus consecuencias. Tres nidos fueron estudiados y en dos de ellos hubo eclosión del huevo despues de varios abandonos sufridos. Este abandono temporal parece ser un comportamiento bastante difundido entre los Procellariiformes, y sería el un comportamiento

oportunístico a objeto de modificar la lonitud del periodo de incubación con lo cual se logra que, al momento de abandonar esos lugares, los polluelos de este petrel encuentren abundante alimento en el mar mientras realizan su primera migración.

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museum of natural history, university of kansas, lawrence, kansas 66044; (present address) universidad de chile, santiago, chile.
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PRODUCTIVITY, POPULATION DYNAMICS, AND SYSTEMATICS OF GRANIVOROUS BIRDS

This book, edited by S. C. Kendeigh and J. Pinowski and published by the Polish Academy of Sciences, Warsaw (410 pp., 1973), may be obtained from Dr. S. C. Kendeigh, Vivarium Building, Wright and Healey Streets, Champaign, Illinois, 61820, for $13.00, plus $.60 for postage and handling (total $13.60). The book covers the Proceedings of the First General Meeting of the Working Group on Granivorous Birds of the International Biological Program held at the Hague, Holland, September 6–8, 1970. The major subjects discussed are (1) Bioenergetics, (2) Population dynamics and related aspects of behavior, (3) Food, in relation to the primary production of cereals and weeds—economic aspects, (4) Systematics and evolutionary biology of sparrows, and (5) Miscellaneous problems. Altogether there are 31 separate papers authored by 43 persons from 16 countries. Two species of common birds receive principal attention, the House Sparrow and European Tree Sparrow, but consideration is also given to a number of other species so that principles brought out have application to birds in general.